

**SYSTEM AND METHOD FOR CALLER CONTROLLED TIME DEMARCATION****NOTICE OF COPYRIGHT PROTECTION**

[0001] A portion of the disclosure of this patent document and its figures contain material subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure, but otherwise reserves all copyrights whatsoever.

**FIELD OF THE INVENTION**

[0002] The present invention relates generally to advanced telecommunications services. The present invention relates more particularly to caller-controlled demarcation of communications.

**BACKGROUND**

[0003] A common challenge facing parents in relation to conventional telephones is the propensity of teenagers to overuse the telephone. Despite the best efforts of parents, it has proven difficult to control this propensity. Parents have a strong desire to limit the duration of their teenagers' calls to the extent possible to both reduce their monthly phone bill and increase the availability of their phone. Additionally, other telephone subscribers may wish to limit the number and duration of phone calls and other telecommunications

for a variety of reasons, including attempting to reduce the size of their monthly telephone bill.

**[0004]** Various conventional methods for monitoring or limiting the duration of a call exist. For example, many conventional business-style phones, such as those connected to private branch exchanges (PBX), include a timer, which is activated when a phone call begins. By monitoring the display, a caller can determine the running duration of the call and end the call when the desired duration has expired. However, the phone itself includes no mechanism to limit the duration of the call and neither does the underlying telecommunications system. The phone merely provides an indication of the length of the call. For a subscriber wishing to limit the duration of calls by other parties, an indicator provides little value.

**[0005]** Another indicator of call duration is the periodic phone bill. The phone bill provides feedback to the subscriber of the duration of calls to various directory numbers. However, the phone bill is historical and provides no ability to limit the duration of currently-occurring calls.

**[0006]** Other methods exist for limiting the actual duration of calls. For example, the patent granted Nguyen, et. al., U.S. Pat. No. 5,815,561, describes "a method and system for apprising the parties to a communication of the duration of the communication while the communication is in progress." Nguyen dismisses having a caller set up a call demarcation as inefficient and time-consuming. Also, Nguyen does not teach demarcation for a call terminating at the subscriber's phone.

[0007] Conventional methods and systems also provide for limiting a call placed using a prepaid calling card. A subscriber provides the prepaid calling card number when placing the call. Based on the billing rate for a particular phone call, the duration of the call is calculated as a time period equal to the monetary value on the prepaid card divided by the billing rate for the call. If the time period expires during the call, the call is disconnected. In any event, when the call ends, the duration of the call is deducted from the prepaid card balance.

[0008] In comparison to a caller-controlled demarcation, several limitations exist when using prepaid cards. One obvious limitation of a prepaid calling card is that the card must be purchased before a call can be placed using the card. Also, the card must be replaced or have value added when the monetary value of the card is depleted. Additionally, a caller may apply the monetary value of the prepaid card to any call. No system or method exists to limit specific calls to only a portion of the prepaid card or to only specific directory numbers.

[0009] For these reasons and others, a system and method is needed to provide an indicator or to limit the duration of phone calls and other communications. It would be most advantageous if the system and method were embodied as a service in an intelligent network, allowing a subscriber to vary the time limit of calls placed to or received from various directory numbers and to apply the limit to various time periods. It would also be advantageous to provide the subscriber with the ability to set the limit at any time, including during the instantiation of a call subject to the time limit.

### SUMMARY

[0010] Embodiments of the present invention address these deficiencies in conventional systems and methods by providing systems and methods for caller-controlled time demarcation. An embodiment of the present invention is advantageously embodied as a service in an intelligent telecommunications network. In such a network, a service control point provides a platform for configuration and implementation of the demarcation service.

[0011] In an embodiment of the present invention, the intelligent network comprises an advanced intelligent network (AIN). The AIN comprises a switch, such as a service switching point, in addition to the service control point. The AIN also comprises high-speed signaling system 7 (SS7) links between the switch and service switching points. The AIN also comprises analog and digital connections to terminals, such as telephones, faxes and other devices.

[0012] The switch receives a communication from a terminal and requests communication-handling instructions from the service switching point. The service control point receives the communication from the switch and in response, searches a database to determine if any advanced services are associated with either the originating or terminating terminal and communicates this information to the switch. The switch then performs functions in accordance with the instructions.

[0013] In an embodiment of the present invention, a telecommunications service provider utilizes the AIN components to provide the caller-controlled demarcation service to the provider's subscribers. The subscribers may subscribe to the demarcation service explicitly or may use the service when desired without first subscribing to it. When a subscriber subscribes to or uses the demarcation service, the subscriber performs configuration tasks, including specifying demarcation information.

[0014] The demarcation information includes a demarcation interval. The demarcation interval is a period of time or a monetary amount. In an embodiment of the present invention, when the switch receives a communication, the switch pauses and sends a message to the service control point, requesting communication-handling instruction. The service control point queries a database and determines that the demarcation service applies to the communication. The service control point finding an entry indicates that the subscriber subscribed to the demarcation service and during the subscription process, provided a default demarcation interval. The service switching point determines the demarcation interval and communicates the communication-handling instructions, including the demarcation interval to the switch.

[0015] In an embodiment of the present invention in which the demarcation interval is stored as a monetary value, the service switching point determines the billing rate of the call, divides the billing rate into the demarcation interval to determine a demarcation interval expressed as a time period, and sends a message comprising the time period to the switch.

[0016] The switch monitors the duration of a communication, and, when the demarcation interval has or is about to expire, signals the expiration and/or disconnects the communication. The switch may signal the expiration of the demarcation interval by playing a beep, click or other signal to the subscriber's phone, indicating the expiration.

[0017] In one embodiment of the present invention, prior to the expiration of the demarcation interval, the system plays a warning tone to inform the individual using the subscriber's phone that the demarcation interval is about to expire. The period of time prior to expiration may comprise one minute or any other period specified by the subscriber or service provider.

[0018] When the communication ends, either because the switch disconnected the communication or because the parties to the call ended it, the switch sends a message to the service switching point, identifying the communication and specifying its duration. In response, the service switching point deducts the duration of the communication from the total demarcation interval stored in the service switching point.

[0019] A demarcation interval applies to a specific time period, for example, a day, week, month, or year. The demarcation interval represents the total duration of a call or group of related calls during the specified period. For example, if the demarcation interval for calls between the subscriber's phone and another directory number is 60 minutes and the time period to which the demarcation interval applies is daily, phone calls to and from the subscriber's phone and the other number may not exceed 60 minutes during any twenty-four hour period. The demarcation interval may apply to the directory

number of the subscriber's phone as either the origination or termination point in a communication.

[0020] In one embodiment of the present invention, the demarcation information comprises a default demarcation interval that applies to all communications, including communications wherein the subscriber's directory number is either the origination or termination point. In another embodiment of the present invention, the demarcation information comprises a plurality of directory numbers to which varying demarcation intervals apply. For example, the subscriber may specify that demarcation does not apply to calls to specified directory numbers. Also, the subscriber may specify a default demarcation interval that applies only to a limited set of directory numbers and no others.

[0021] For example, a subscriber may desire to limit calls between the subscriber's phone and the directory number of a friend of the subscriber's child. In an embodiment of the present invention, the subscriber specifies the directory number of the child's friend, the demarcation interval, and the time period to which the interval applies. When a call is subsequently placed between the subscriber's phone and the child's friend's directory number, the call is subject to the demarcation interval. The demarcation interval applies when either the subscriber's child or the child's friend initiates a communication that includes the subscriber's phone as the origination or termination point.

[0022] A subscriber may enter a demarcation interval as a time value or as a monetary value. If the interval is a monetary value, an embodiment of the present

invention uses the billing rate for a specific call to convert the monetary value to a period of time applicable to the specific communication. The time period represented by the monetary value varies depending on various factors, including the time of day and physical distance the communication traverses.

[0023] The demarcation interval may apply to both voice and data communications. For example, a subscriber may wish to limit the number of minutes the subscriber's phone is connected an Internet service provider (ISP) in order not to exceed the number of access minutes provided in the subscribers service agreement with the ISP.

[0024] In an embodiment of the present invention, a subscriber or a user of the subscriber's telephone may specify a demarcation interval that is less than the default. A subscriber may also specify a demarcation interval that is greater than the default by specifying the demarcation interval and supplying a password. For example, the subscriber may specify that the limit does not apply to a specific communication or that the demarcation interval for the particular communication is infinite.

[0025] When the subscriber or user specifies an override demarcation interval and supplies a password, the switch receives the entry and sends it to the service switching point. The service switching point compares the demarcation interval to the default demarcation interval, and if the entered demarcation interval is greater, validates the password. If the password is valid, the service switching point instructs the switch to use the entered demarcation interval rather than the default demarcation interval. In response



to the communication from the service switching point, the switch routes the call and begins timing it.

[0026] An embodiment of the present invention bills a subscriber for the use of the service. A system and method according to the present invention may bill a subscriber a monthly rate for providing the demarcation service. The subscriber may be charged on a per-use basis for the service instead. Other embodiments of the present invention may combine these billing methods and/or others.

[0027] An embodiment of the present invention offers numerous advantages over conventional approaches. First, an embodiment of the present invention offers potential cost savings to both a subscriber and a provider of demarcation services. An embodiment of the present invention provides a telephone subscriber with a means to limit phone calls placed from and to the subscriber's phone in general and to specifically limit phone calls to specified directory numbers. By allowing the subscriber to specify limits on the duration of phone calls, an embodiment of the present invention potentially reduces the periodic charges that the subscriber pays for phone service.

[0028] Also, by providing an automated means for a subscriber to enter and modify demarcation information, an embodiment of the present invention reduces the number of customer service representatives the service provider must make available to support the service. This reduction in human resources requirements provides a cost savings to the provider.

[0029] An embodiment of the present invention provides numerous other advantages as well. An embodiment of the present invention lessens the likelihood that a user of the subscriber's phone can elude the limitations placed on phone calls. For example, a user of the subscriber's phone may attempt to avoid the demarcation limit by having another party originate a communication to the subscriber's phone. An embodiment of the present invention prevents this attempt by applying the demarcation interval to calls both originating and terminating at the subscriber's phone.

[0030] Also, an embodiment of the present invention operates in a manner that is similar to a pre-paid calling card in that a monetary limit may be placed on a call. However, in an embodiment of the present invention, the caller specifies the demarcation interval as a monetary value. In the case of a pre-paid card, the duration of the call may extend to any duration, so long as the monetary value represented by the card is not exceeded. No limit may be placed on specific directory numbers or applied to specific periods of time. An embodiment of the present invention provides the subscriber with the ability to set demarcation intervals with better specificity.

[0031] Further details and advantages of the present invention are set forth below.

#### **BRIEF DESCRIPTION OF THE FIGURES**

[0032] These and other features, aspects, and advantages of the present invention are better understood when the following Detailed Description is read with reference to the accompanying drawings, wherein:

Figure 1 is a diagram of a prior art advanced intelligent network, which serves as an exemplary environment for operation of an embodiment of the present invention.

Figure 2 is a flowchart illustrating the process of configuring call demarcation in an embodiment of the present invention.

Figure 3 is a flowchart illustrating an overview of the call-handling process in an embodiment of the present invention.

Figures 4a and 4b are a flowchart illustrating the process of handling a call in an active intelligent network in an embodiment of the present invention.

Figure 5 is a message flow diagram illustrating the process of handling a call in which a demarcation interval applies to the originating station in an embodiment of the present invention.

Figure 6 is a message flow diagram illustrating the process of handling a call in which a demarcation interval applies to the terminating station in an embodiment of the present invention.

Figure 7 is a message flow diagram illustrating the process of handling a call in which a demarcation interval applies to the terminating station and the demarcation interval is derived from a subscription or prepaid calling card in an embodiment of the present invention.

### **DETAILED DESCRIPTION**

[0033] Embodiments of the present invention provide systems and methods for caller-controlled time demarcation of voice-channel communications. An embodiment of the present invention is advantageously embodied in an intelligent telephone network, such as an advanced intelligent network. A user of an embodiment of the present invention accesses the demarcation service, utilizing a special code or dialing a number, enters a password, and specifies demarcation information, including a demarcation interval. Once the subscriber specifies a demarcation interval, during subsequent calls to which the demarcation interval applies, the service either causes the playing of a tone or message or causes the disconnection of the call after a period of time equal to the demarcation interval.

[0034] A service provider may provide an embodiment of the present invention to all the provider's subscribers. A subscriber may access the service at any time and need not subscribe to the service prior to using it. A mobile telecommunications service provider in a mobile telecommunications network may also provide the demarcation service.

#### Advanced Intelligent Network

[0035] Figure 1 is a block diagram of a prior art public switched telephone network (PSTN) 102 and an advanced intelligent network (AIN) 104. An embodiment of the present invention is advantageously embodied as a service in AIN 104. For the sake of brevity, only a basic description of the AIN is provided herein. For further information

regarding aspects of the AIN, refer to Nguyen, U.S. Pat. No. 5,815,561, which is incorporated herein by reference.

[0036] PSTN 102 represents a voice telecommunications network. PSTN 102 comprises a plurality of telecommunication equipment, including various AIN components. AIN 104 illustrates the telecommunications components typically owned or administered by a local exchange carrier. These components communicate out-of-band over signaling system 7 (SS7) links 116. SS7 is a standard protocol for setting up calls and providing communication features within AIN 104.

[0037] A local exchange carrier locates AIN components in various physical locations to ensure the most efficient utilization of each component. For example, AIN 104 comprises a plurality of central offices (not shown). A central office comprises AIN components, including voice switches for providing voice-line communications services. Voice-line communication comprises both voice and data services, such as dial-up Internet access. A voice switch may incorporate or communicate with a service switching points (SSP), illustrated as service switching points 112a and 112a. An SSP 112a provides intelligent call handling and routing. "SSP" and "switch" are used interchangeably herein to refer to an intelligent voice telecommunications switch.

[0038] Switches are interconnected through a series of communication links called trunks. Switches utilize trunks to establish communication links between terminals, such as telephones, faxes, and modems. Referring to Figure 1, SSP 112a and SSP 112b are interconnected by trunk 122. SSP 112a provides switching and additional intelligent

network functionality by working in conjunction with various other components of an AIN 104. For example, SSP 112a communicates with a local signal transfer point (STP) 114. An STP, illustrated by STP 114 in Figure 1, is a packet switch that routes communication requests between the various elements in AIN 104, including SSP 112a and service control points, as illustrated by SCP 118 in Figure 1.

[0039] For example, SSP 112a sends a query message in response to a trigger to STP 114. Although Figure 1 includes a single SCP 118 for illustration purposes, AIN 104 comprises a plurality of additional SCPs as well (not shown). STP 114 queries its database (not shown) to determine to which SCP the query message from SSP 112a is to be directed.

[0040] SCP 118 provides program logic, translation, and routing data required to deliver advanced network features, such as calling card, 800, and other services. To support such advanced features, SCP 118 accesses a database 120. SCP 118 may incorporate a database, such as database 120, or may access a database on a separate computer (not shown). To ensure continuity of service an SCP 118 generally comprises redundant fault-tolerant computers. Also, AIN 104 incorporates SCPs in tandem to further insure continuity of service.

[0041] SSP 112a and SCP 118 communicate via transactional capabilities application part (TCAP) messages over signaling system 7 (SS7) links. TCAP comprises the top layer of the SS7 protocol and supports transactional, non-circuit related, exchange between AIN 104 components.

[0042] A terminal initiates a communication. In the embodiment shown in Figure 1, terminals are represented by telephones 106, 108, 110. However, numerous devices may operate as terminals in an embodiment of the present invention.

[0043] Terminals initiate communications at switches. The terminals communicate with the switches via analog or digital communication channels 114. A communication may comprise a single terminal, such as first station 108. For example, if a subscriber wishes to perform administrative functions, such as setting up a demarcation interval in an embodiment of the present invention, the subscriber uses first station 108 to initiate a communication with SSP 112a. No other terminals are involved in the transaction.

[0044] When SSP 112a receives a communication from first station 108, a trigger occurs. A trigger is an event in the AIN 104 that causes the SSP 112a to send a message to the SCP 118, requesting instructions for how to handle a communication. In response, the SCP 118 provides instructions to the SSP 112a. The instructions may include a directive to play an announcement, route the call, collect digits, or perform other tasks necessary to provide an advanced service.

[0045] When an SSP 112a identifies a trigger and pauses to send a message, the SSP 112a opens a transaction, which causes an allocation of the memory of SSP 112a. Also, when the SCP 118 receives a message from the SSP 112a, the SCP 118 opens a transaction, causing an allocation of memory on the SCP 118. The memory allocated on the SSP 112a and SCP 118 remains allocated until the bi-directional communication between the two components ends and the transaction is closed. Therefore, it is

advantageous to maintain open transactions only as long as necessary so that the memory allocated for the transaction may be deallocated and utilized to support additional transactions.

[0046] An embodiment of the present invention utilizes an AIN software release 0.1 or higher. For more information see, see Bellcore Specification TR-NWT-001284 Switching Systems Generic Requirements for AIN 0.1, which is incorporated herein by reference. AIN software supports a call model comprising points in call (PIC), trigger detection points (TDP), and triggers. SSP 112a checks at each TDP to see if there are any active triggers. If SSP 112a detects an active trigger, call processing is paused until the SSP 112a and SCP 118 complete a transaction. AIN release 0.1 and higher includes a formal call model, which comprises both originating and terminating call models.

[0047] AIN 104 may comprise additional components as well. For example, AIN 104 includes a service management system (SMS) 124. SMS 124 allows the creation and maintenance of information relating to subscribers and services in near real-time for both billing and administration of AIN 104. SMS 124 downloads information to the databases of SCP 118 when subscribers add or modify AIN services. Also, SMS 124 downloads billing information necessary to bill subscribers for AIN services.

#### Configuring Caller-Controlled Call Demarcation

[0048] In an embodiment of the present invention, the subscriber to the demarcation service may set up the demarcation service by subscription, setting a default demarcation



interval, or may instead activate the demarcation service for specific calls to and from the subscriber's phone. Also, an embodiment of the present invention is not limited to applying the demarcation limit to communications to a specific device. The demarcation interval may be applied to various devices to which communications intended for the subscriber are directed. Figure 2 provides a general description of the process of configuring a caller-controlled demarcation service.

[0049] In an embodiment of the present invention, the subscriber uses a terminal, such as first station 108 shown in Figure 1, to access the caller-controlled call demarcation service. The subscriber may access the service by various methods, including dialing a specific directory number or using a special access code in the form, \*##. Referring to Figure 2, a first network element, SSP 112a, receives the communication 202 across a voice channel communication link. 114c. The user has a \*XX feature code trigger on the line to allow them to dial the \*XX code. The SSP 112a receives this code 204.

[0050] SSP 112a sends a request for call-handling instructions over an SS7 link to SCP 118 via STP 114, 208. When STP 114 receives the request, STP 114 searches a table (not shown) to determine the address of SCP 118 and forwards the request to SCP 118.

[0051] SCP 118 includes logic, including a caller-controlled call demarcation entry component, and a database 120, which includes a demarcation information data store. In response to receiving the request from SSP 112a, SCP 118 opens a transaction and

responds, instructing SSP 112a to play an announcement requesting the subscriber to enter the demarcation information, including the demarcation interval 210. The demarcation information may include other parameters as well.

[0052] For example, the subscriber may specify a time period to which the demarcation interval applies. Also, the subscriber may specify directory numbers to which the demarcation interval applies.

[0053] A demarcation interval may apply to a single call or may apply to calls occurring during a specific time period, for example, a day, week, month, or year. The demarcation interval represents the total duration of a call or group of related calls during the specified period. For example, if the demarcation interval for calls between the subscriber's phone and another directory number is 60 minutes and the time period to which the demarcation interval applies is daily, phone calls to and from the subscriber's phone and the other number may not exceed 60 minutes during any twenty-four hour period. The demarcation interval may apply to the directory number of the subscriber's phone as either the origination or termination point in a communication.

[0054] Referring again to Figure 2, SSP 112a receives the demarcation information 213 and communicates the information to SCP 118, 214. The SCP 118 receives the demarcation information and stores it in the database 120, 216.

[0055] After the subscriber has configured the demarcation service, any calls placed to or from the subscriber's phone may be subject to a demarcation interval. As stated

herein, the subscriber may also initiate the demarcation service on a call-by-call basis without performing an initial configuration.

[0056] For example, prior to beginning a conversation, the subscriber may specify that the demarcation interval applied to the current call is thirty minutes. The subscriber may further specify that when the demarcation interval expires, the switch should simply supply an indicator rather than disconnecting the communication. In this way, the subscriber is reminded to complete the call at the end of thirty minutes, but the subscriber is not abruptly cut off.

[0057] Figure 3 illustrates the process an SCP 118 executes to handle a call subsequent to initial configuration of the demarcation service. In the embodiment shown in Figure 3, the SCP 118 receives a communication from an SSP 112a, 302. The communication from the SSP 112a includes information for identifying the terminal or terminals that are to participate in the communication, such as first station 108 and second station 110. The SCP 118 uses this information to identify the terminals and queries database 120 to determine if any services are associated with either terminal 304.

[0058] In the process shown in Figure 3, the SCP 118 also receives demarcation information, including a demarcation interval, from the SSP 112a, 306. The SCP 118 queries the database 120 to determine the default demarcation interval specified by the subscriber during configuration as illustrated in Figure 2 308. In the case of the process illustrated in Figure 3, the SCP 118 finds a default interval in database 120. The SCP 118

compares the default interval with the demarcation interval received from the SSP 112a to determine if the provided interval is greater than the default interval 310.

[0059] If the demarcation interval entered is greater than the default interval, the SCP 118 sends a message to the SSP 112a, requesting an announcement be played that states that a demarcation interval greater than the default may not be entered without a password 312. The SCP 118 also requests the SSP 112a to collect the subscriber's password 314. The SSP 112a plays the announcement, collects the password, and sends it to the SCP 118 for verification. SCP 118 receives the password 316 and validates it 318. In another embodiment of the present invention, the subscriber provides the demarcation interval and the password in a single communication

[0060] If either the provided demarcation interval is less than or equal to the default interval or the subscriber enters a valid password, the process shown in Figure 3 continues to step 320. The subscriber may specify a period of time to which a demarcation interval applies. For example, a subscriber may allow a total of 60 minutes of calls between the subscriber's and another phone per day. The subscriber may also specify that phone calls to all numbers may not exceed 240 minutes per week. The SCP 118 receives the time period for the demarcation interval 316. The SCP 118 may also search database 120 for a stored time period to apply to a demarcation interval.

[0061] SCP 118 may receive additional information as well 322. For example, a subscriber may specify the directory numbers to which a demarcation interval applies. The parameters described herein in relation to the caller-controlled demarcation service

are not exhaustive. A subscriber may specify many additional parameters. Once the subscriber has specified all desired parameters, the SCP 118 stores the parameters in database 120, and instructs SSP 112a to route the call 324.

Demarcated Call Handling Service in an AIN

[0062] In an embodiment of the present invention, once the subscriber has specified the parameters for demarcated call handling, the AIN 104 implements the call demarcation service for calls originating from or terminating at the subscriber's telephone. Figures 4a and 4b illustrate the process for handling calls in an AIN 104 to and from the subscriber's phone subsequent to call demarcation configuration.

[0063] In an embodiment of the present invention, a party places a call from the subscriber's phone, first station 108, to another phone, for example, second station 110. SSP 112a receives the communication and pauses 402. SSP 112a identifies the appropriate trigger, opens a transaction, and sends a query message to SCP 118 via STP 114, 404. SCP 118 includes logic, including a call demarcation component, and a database 120, which includes a demarcation information data store. The query message comprises information identifying first station 108 and the target termination point, second station 110, as well as other information necessary to identify the call.

[0064] SCP 118 receives the query message and opens a transaction 406. The SCP 118 receives the originating and terminating station directory numbers 408. SCP 118 receives any additional information included in the query message as well. In response,

SCP 118 performs a query of database 120 to determine whether any advanced services, such as demarcation, are to be applied to the communication. In the process shown in Figure 4a, SCP 118 queries database 120 to determine whether demarcation information exists for either the originating station, first station 108, or the terminating station, second station 110, 410.

[0065] An embodiment of the present invention will provide demarcation for a subscriber's phone as either the originating or terminating station. For example, if the subscriber sets up a demarcation interval for calls between first station 108 and second station 110. The AIN 104 may enforce the demarcation interval on calls placed from second station 110 to first station 108 as well as calls placed from first station 108 to second station 110.

[0066] If the SCP 118 finds no demarcation information that is applicable to a communication between first station 108 and second station 110, SCP 118 sends a message to SSP 112a, instructing SSP 112a to route the call. The SSP 112a routes the call 412 and closes the transaction 413 and continues with step 438 in Figure 4b.

However, if a demarcation interval does exist, the SCP 118 may also receive a demarcation interval override and password in the message from SSP 112a.

[0067] A call originating from first station 108 to which demarcation applies is subject to the default demarcation interval, which the subscriber provided during configuration, for calls to and from first station 108. However, if a subscriber wishes to

override the demarcation interval for a specific call, the subscriber may provide a demarcation interval override as well as a password.

[0068] In the process shown in Figure 4a, the subscriber has provided an override demarcation interval and password. The SCP 118 validates the password by querying database 120, 414. If the password is valid, the demarcation interval is set to the value received in the message 416. If the password is invalid, the demarcation interval is set to the default demarcation interval for first station 108, 418. Another embodiment of the present invention ends the communication when the password is invalid. In another embodiment of the present invention, if the subscriber enters an invalid password the SCP 118 instructs the SSP 112a to request the password again so that the subscriber may correct the previous error.

[0069] Referring again to Figure 4a, once the password is validated or found to be invalid, the SCP 118 sends a response message to the SSP 112a, including the demarcation interval that the SSP 112a is to apply to the communication and closes the transaction 422. The SSP 112a receives the message from the SCP 112a and closes the transaction 424.

[0070] The SSP 112a then routes the communication to second station 110, establishing a voice channel communication link on trunk 122 to SSP 112a and begins timing the communication 426. When the demarcation interval expires, the SSP 112a executes a demarcation 428. Demarcation may comprise playing a tone, signifying the expiration of the demarcation interval, or may comprise disconnecting the call.

[0071] In an embodiment of the present invention, prior to the expiration of the demarcation interval, SSP 112a may play a warning tone to inform the individual using the subscriber's phone that the demarcation interval is about to expire. The period of time prior to expiration may comprise one minute or any other period specified by the subscriber or service provider.

[0072] The process illustrated in Figure 4a continues in Figure 4b. When the call ends, either because SSP 112a ended it after the expiration of the demarcation interval or because the parties to the call ended the call, the SSP 112a identifies a trigger and opens a unidirectional link to the SCP 118, 430. The SSP 112a then sends the duration of the call to the SCP 118 and closes the transaction 432.

[0073] The SCP 118 receives the duration of the communication as well as information identifying aspects of the communication 432. For example, the SSP 112a and SCP 118 may use a unique number to identify each call. When the SSP 112a communicates the duration of the call, the SSP 112a includes the call identifier in the message. The SCP 118 decrements the demarcation interval if necessary, subtracting the duration of the call from the total demarcation interval allowed for the first station 108 or for calls between first station 108 and second station 110, 436. The SCP 118 then closes the transaction 438. The process ends 440.



**[0074]**      Origination-Side Demarcated Call Handling in an AIN

**[0075]**      The AIN protocol defines a common set of message that AIN components exchange when providing advanced telecommunications services, such as the query message, conversation message, response message and unidirectional message. Certain messages perform specific functions. The messages include the Info\_Collected, Analyze\_Route and Termination\_Notification messages.

**[0076]**      Figure 5 is a message flow diagram, illustrating the messages that the SSP 112a and SCP 118 exchange for a demarcated call originating from the subscriber's phone, first station 108, and directed to second station 110. Arrows indicate message flow between SSP 112a and SCP 118 over time.

**[0077]**      In the embodiment shown in Figure 5, the subscriber initiates a telephone call on first station 108. SSP 112a receives the communication 502. The SSP112a identifies an off-hook delay trigger 504. An off-hook delay trigger allows the SSP 112a to pause and send a message to the SCP 118. For example, if the subscriber dials 911, the SSP 112a escapes the off-hook delay trigger. The SSP 112a immediately routes the call and does not pause while waiting for instructions.

**[0078]**      Referring again to Figure 5, in response to the trigger, the SSP 112a pauses and opens a transaction 506. The SSP 112a sends an Info\_Collected message to the SCP 118, including any necessary parameters 508. The SSP 112a and the SCP 118 engage in a bi-directional communication to gather the required demarcation to setup the communication between first station 108 and second station 110. SCP 118 sends a

Send\_Notification message to the SSP 112a, including an Echo\_Data parameter, which is subsequently returned to the SCP 118 in the Termination\_Notification message described below. The Echo\_Data parameter in each message contains an identification number that serves to identify the specific communication to which the messages apply.

[0079] The SCP 118 receives the Info\_Collected message and, in response, opens a transaction 510. The SCP 118 performs logic and may query database 120 and then sends a response message, a Send\_Resource message 512. The SSP 112a receives the Send\_Resource message and, in response, plays an announcement and collect digits 514. Once the SSP 112a finishes collecting digits, the SSP 112a sends a Resource\_Clear message, containing the information, to the SCP 118, 516.

[0080] The SCP 118 processes the information in the Resource\_Clear message, validating a password if necessary and determining the demarcation interval 518. The SCP 118 next sends an Analyze\_Route message to the SSP 112a, which includes a midCallTimer parameter, and a Send\_Notification message, instructing the SSP 112a to notify the SCP 118 upon termination of the communication 520. The midCallTimer parameter contains the demarcation interval for the call. The SCP 118 then closes the transaction 522. The Analyze\_Route message may include additional parameters as well, such as an Echo\_Data parameter, which includes a unique identification number of the communication and which the SSP 112a will later return to the SCP 118 to identify the communication.

[0081] SCP 118 sends a Send\_Notification message to the SSP 112a, including an Echo\_Data parameter, which is returned to the SCP 118 in the Termination\_Notification message. The Echo\_Data parameter in each message contains an identification number that serves to identify the specific communication to which the messages apply.

[0082] The SSP 112a receives the Analyze\_Route message and, in response, closes the transaction 524. The SSP 112a utilizes the midCallTimer parameter to set a timer for the call and routes the call 526.

[0083] Assuming the call is answered at second station 110, the timer begins timing the call. When the timer expires, an embodiment of the present invention either plays a demarcation signal or disconnects the call 528. Also, the call may end prior to expiration of the demarcation interval. In any case, when the call ends, the SSP 112a sends a unidirectional Termination\_Notification message to the SCP 118, 530.

[0084] The Termination\_Notification message comprises an identifier of the communication as well as the duration of the call. A Termination\_Notification message is a unidirectional message, a message not associated with a transaction. The SCP 118 receives the Termination\_Notification message and, if necessary, subtracts the duration of the communication from the demarcation interval remaining in database 120, 532.

#### Termination-Side Demarcated Call Handling in an AIN

[0085] Figure 6 is a message flow diagram, illustrating the messages that the SSP 112a and SCP 118 exchange for a demarcated call originating at second station 110 and

directed to the subscriber's phone, first station 108. Horizontal arrows indicate message flow between SSP 112a and SCP 118.

[0086] In the embodiment shown in Figure 6, SSP 112a receives a communication from second station 110, 602. The SSP112a identifies a Termination\_Attempt Trigger 604. In response, the SSP 112a pauses and opens a transaction 606. The SSP 112a sends a Termination\_Attempt message to the SCP 118, including any necessary parameters

608. The SCP 118 receives the Termination\_Attempt message and, in response, opens a transaction 610. The SCP 118 processes the information contained in the Termination\_Attempt message and determines the demarcation interval 612. The SCP 118 sends an Authorize\_Termination message to the SSP 112a, which includes a midCallTimer parameter, and Send\_Notification, instructing the SSP 112a to notify the SCP 118 when the communication ends 614. The midCallTimer parameter specifies the demarcation interval for the call. The SCP then closes the transaction 616.

[0087] The SSP 112a receives the Authorize\_Termination message and, in response, closes the transaction and connects the call 618. The SSP 112a utilizes the midCallTimer parameter to set a timer for the call 620.

[0088] When the timer expires, the SSP 112a either plays a demarcation signal or disconnects the call 622. Also, the call may end prior to expiration of the demarcation interval. In either situation, when the call ends, the SSP 112a sends a unidirectional Termination\_Notification message to the SCP 118, 624. The Termination\_Notification message comprises an identifier of the communication as well as the duration of the call.

The SCP 118 receives the Termination\_Notification message and, if necessary, subtracts the duration of the communication from the demarcation interval remaining in database 120, 626.

Subscription-based Termination-Side Demarcated Call Handling in an AIN

[0089] Another embodiment of the present invention utilizes subscription information to determine the demarcation interval for a call terminating at the subscriber's phone.

The message flow illustrated in Figure 7 is almost precisely the same as that illustrated in Figure 6. However, in Figure 7, the demarcation interval is calculated based on a subscription. The caller does not control the demarcation interval dynamically.

[0090] Figure 7 is a message flow diagram, illustrating the messages that the SSP 112a and SCP 118 exchange for a demarcated call originating at second station 110 and directed to the subscriber's phone, first station 108. As in Figure 6, horizontal arrows indicate message flow between SSP 112a and SCP 118.

[0091] In the embodiment shown in Figure 7, SSP 112a receives a communication from second station 110, 702. The SSP112a identifies a Termination\_Attempt Trigger 704. In response, the SSP 112a pauses and opens a transaction 706. The SSP 112a sends a Termination\_Attempt message to the SCP 118, including any necessary parameters 708. The SCP 118 receives the Termination\_Attempt message and, in response, opens a transaction 710. The SCP 118 processes the information contained in the Termination\_Attempt message and determines the demarcation interval 712. The

demarcation interval is calculated based on a value specified during subscription to the demarcation service. In the embodiment shown in Figure 7, the subscriber cannot dynamically vary the demarcation interval.

[0092] After determining the demarcation interval, the SCP 118 sends an Authorize\_Termination message to the SSP 112a, which includes a midCallTimer parameter, and Send\_Notification, instructing the SSP 112a to notify the SCP 118 when the communication ends 714. The midCallTimer parameter specifies the demarcation interval for the call. The SCP then closes the transaction 716.

[0093] The SSP 112a receives the Authorize\_Termination message and, in response, closes the transaction and connects the call 718. The SSP 112a utilizes the midCallTimer parameter to set a timer for the call 720.

[0094] When the timer expires, the SSP 112a either plays a demarcation signal or disconnects the call 722. Also, the call may end prior to expiration of the demarcation interval. In either situation, when the call ends, the SSP 112a sends a unidirectional Termination\_Notification message to the SCP 118, 724. The Termination\_Notification message comprises an identifier of the communication as well as the duration of the call. The SCP 118 receives the Termination\_Notification message and subtracts the duration of the communication, as a time or monetary value, from the demarcation interval remaining in database 120, 726. The monetary value of the duration of the communication is calculated by multiplying the duration of the communication by the billing rate for the communication.

[0095] The foregoing description of the preferred embodiments of the invention has been presented only for the purpose of illustration and description and is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Numerous modifications and adaptations thereof will be apparent to those skilled in the art without departing from the spirit and scope of the present invention.

11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100  
101  
102  
103  
104  
105  
106  
107  
108  
109  
110  
111  
112  
113  
114  
115  
116  
117  
118  
119  
120  
121  
122  
123  
124  
125  
126  
127  
128  
129  
130  
131  
132  
133  
134  
135  
136  
137  
138  
139  
140  
141  
142  
143  
144  
145  
146  
147  
148  
149  
150  
151  
152  
153  
154  
155  
156  
157  
158  
159  
160  
161  
162  
163  
164  
165  
166  
167  
168  
169  
170  
171  
172  
173  
174  
175  
176  
177  
178  
179  
180  
181  
182  
183  
184  
185  
186  
187  
188  
189  
190  
191  
192  
193  
194  
195  
196  
197  
198  
199  
200  
201  
202  
203  
204  
205  
206  
207  
208  
209  
210  
211  
212  
213  
214  
215  
216  
217  
218  
219  
220  
221  
222  
223  
224  
225  
226  
227  
228  
229  
230  
231  
232  
233  
234  
235  
236  
237  
238  
239  
240  
241  
242  
243  
244  
245  
246  
247  
248  
249  
250  
251  
252  
253  
254  
255  
256  
257  
258  
259  
260  
261  
262  
263  
264  
265  
266  
267  
268  
269  
270  
271  
272  
273  
274  
275  
276  
277  
278  
279  
280  
281  
282  
283  
284  
285  
286  
287  
288  
289  
290  
291  
292  
293  
294  
295  
296  
297  
298  
299  
300  
301  
302  
303  
304  
305  
306  
307  
308  
309  
310  
311  
312  
313  
314  
315  
316  
317  
318  
319  
320  
321  
322  
323  
324  
325  
326  
327  
328  
329  
330  
331  
332  
333  
334  
335  
336  
337  
338  
339  
340  
341  
342  
343  
344  
345  
346  
347  
348  
349  
350  
351  
352  
353  
354  
355  
356  
357  
358  
359  
360  
361  
362  
363  
364  
365  
366  
367  
368  
369  
370  
371  
372  
373  
374  
375  
376  
377  
378  
379  
380  
381  
382  
383  
384  
385  
386  
387  
388  
389  
390  
391  
392  
393  
394  
395  
396  
397  
398  
399  
400  
401  
402  
403  
404  
405  
406  
407  
408  
409  
410  
411  
412  
413  
414  
415  
416  
417  
418  
419  
420  
421  
422  
423  
424  
425  
426  
427  
428  
429  
430  
431  
432  
433  
434  
435  
436  
437  
438  
439  
440  
441  
442  
443  
444  
445  
446  
447  
448  
449  
450  
451  
452  
453  
454  
455  
456  
457  
458  
459  
460  
461  
462  
463  
464  
465  
466  
467  
468  
469  
470  
471  
472  
473  
474  
475  
476  
477  
478  
479  
480  
481  
482  
483  
484  
485  
486  
487  
488  
489  
490  
491  
492  
493  
494  
495  
496  
497  
498  
499  
500  
501  
502  
503  
504  
505  
506  
507  
508  
509  
510  
511  
512  
513  
514  
515  
516  
517  
518  
519  
520  
521  
522  
523  
524  
525  
526  
527  
528  
529  
530  
531  
532  
533  
534  
535  
536  
537  
538  
539  
540  
541  
542  
543  
544  
545  
546  
547  
548  
549  
550  
551  
552  
553  
554  
555  
556  
557  
558  
559  
560  
561  
562  
563  
564  
565  
566  
567  
568  
569  
570  
571  
572  
573  
574  
575  
576  
577  
578  
579  
580  
581  
582  
583  
584  
585  
586  
587  
588  
589  
590  
591  
592  
593  
594  
595  
596  
597  
598  
599  
600  
601  
602  
603  
604  
605  
606  
607  
608  
609  
610  
611  
612  
613  
614  
615  
616  
617  
618  
619  
620  
621  
622  
623  
624  
625  
626  
627  
628  
629  
630  
631  
632  
633  
634  
635  
636  
637  
638  
639  
640  
641  
642  
643  
644  
645  
646  
647  
648  
649  
650  
651  
652  
653  
654  
655  
656  
657  
658  
659  
660  
661  
662  
663  
664  
665  
666  
667  
668  
669  
670  
671  
672  
673  
674  
675  
676  
677  
678  
679  
680  
681  
682  
683  
684  
685  
686  
687  
688  
689  
690  
691  
692  
693  
694  
695  
696  
697  
698  
699  
700  
701  
702  
703  
704  
705  
706  
707  
708  
709  
710  
711  
712  
713  
714  
715  
716  
717  
718  
719  
720  
721  
722  
723  
724  
725  
726  
727  
728  
729  
730  
731  
732  
733  
734  
735  
736  
737  
738  
739  
740  
741  
742  
743  
744  
745  
746  
747  
748  
749  
750  
751  
752  
753  
754  
755  
756  
757  
758  
759  
760  
761  
762  
763  
764  
765  
766  
767  
768  
769  
770  
771  
772  
773  
774  
775  
776  
777  
778  
779  
780  
781  
782  
783  
784  
785  
786  
787  
788  
789  
790  
791  
792  
793  
794  
795  
796  
797  
798  
799  
800  
801  
802  
803  
804  
805  
806  
807  
808  
809  
810  
811  
812  
813  
814  
815  
816  
817  
818  
819  
820  
821  
822  
823  
824  
825  
826  
827  
828  
829  
830  
831  
832  
833  
834  
835  
836  
837  
838  
839  
840  
841  
842  
843  
844  
845  
846  
847  
848  
849  
850  
851  
852  
853  
854  
855  
856  
857  
858  
859  
860  
861  
862  
863  
864  
865  
866  
867  
868  
869  
870  
871  
872  
873  
874  
875  
876  
877  
878  
879  
880  
881  
882  
883  
884  
885  
886  
887  
888  
889  
890  
891  
892  
893  
894  
895  
896  
897  
898  
899  
900  
901  
902  
903  
904  
905  
906  
907  
908  
909  
910  
911  
912  
913  
914  
915  
916  
917  
918  
919  
920  
921  
922  
923  
924  
925  
926  
927  
928  
929  
930  
931  
932  
933  
934  
935  
936  
937  
938  
939  
940  
941  
942  
943  
944  
945  
946  
947  
948  
949  
950  
951  
952  
953  
954  
955  
956  
957  
958  
959  
960  
961  
962  
963  
964  
965  
966  
967  
968  
969  
970  
971  
972  
973  
974  
975  
976  
977  
978  
979  
980  
981  
982  
983  
984  
985  
986  
987  
988  
989  
990  
991  
992  
993  
994  
995  
996  
997  
998  
999  
1000  
1001  
1002  
1003  
1004  
1005  
1006  
1007  
1008  
1009  
1010  
1011  
1012  
1013  
1014  
1015  
1016  
1017  
1018  
1019  
1020  
1021  
1022  
1023  
1024  
1025  
1026  
1027  
1028  
1029  
1030  
1031  
1032  
1033  
1034  
1035  
1036  
1037  
1038  
1039  
1040  
1041  
1042  
1043  
1044  
1045  
1046  
1047  
1048  
1049  
1050  
1051  
1052  
1053  
1054  
1055  
1056  
1057  
1058  
1059  
1060  
1061  
1062  
1063  
1064  
1065  
1066  
1067  
1068  
1069  
1070  
1071  
1072  
1073  
1074  
1075  
1076  
1077  
1078  
1079  
1080  
1081  
1082  
1083  
1084  
1085  
1086  
1087  
1088  
1089  
1090  
1091  
1092  
1093  
1094  
1095  
1096  
1097  
1098  
1099  
1100  
1101  
1102  
1103  
1104  
1105  
1106  
1107  
1108  
1109  
1110  
1111  
1112  
1113  
1114  
1115  
1116  
1117  
1118  
1119  
1120  
1121  
1122  
1123  
1124  
1125  
1126  
1127  
1128  
1129  
1130  
1131  
1132  
1133  
1134  
1135  
1136  
1137  
1138  
1139  
1140  
1141  
1142  
1143  
1144  
1145  
1146  
1147  
1148  
1149  
1150  
1151  
1152  
1153  
1154  
1155  
1156  
1157  
1158  
1159  
1160  
1161  
1162  
1163  
1164  
1165  
1166  
1167  
1168  
1169  
1170  
1171  
1172  
1173  
1174  
1175  
1176  
1177  
1178  
1179  
1180  
1181  
1182  
1183  
1184  
1185  
1186  
1187  
1188  
1189  
1190  
1191  
1192  
1193  
1194  
1195  
1196  
1197  
1198  
1199  
1200  
1201  
1202  
1203  
1204  
1205  
1206  
1207  
1208  
1209  
1210  
1211  
1212  
1213  
1214  
1215  
1216  
1217  
1218  
1219  
1220  
1221  
1222  
1223  
1224  
1225  
1226  
1227  
1228  
1229  
1230  
1231  
1232  
1233  
1234  
1235  
1236  
1237  
1238  
1239  
1240  
1241  
1242  
1243  
1244  
1245  
1246  
1247  
1248  
1249  
1250  
1251  
1252  
1253  
1254  
1255  
1256  
1257  
1258  
1259  
1260  
1261  
1262  
1263  
1264  
1265  
1266  
1267  
1268  
1269  
1270  
1271  
1272  
1273  
1274  
1275  
1276  
1277  
1278  
1279  
1280  
1281  
1282  
1283  
1284  
1285  
1286  
1287  
1288  
1289  
1290  
1291  
1292  
1293  
1294  
1295  
1296  
1297  
1298  
1299  
1300  
1301  
1302  
1303  
1304  
1305  
1306  
1307  
1308  
1309  
1310  
1311  
1312  
1313  
1314  
1315  
1316  
1317  
1318  
1319  
1320  
1321  
1322  
1323  
1324  
1325  
1326  
1327  
1328  
1329  
1330  
1331  
1332  
1333  
1334  
1335  
1336  
1337  
1338  
1339  
1340  
1341  
1342  
1343  
1344  
1345  
1346  
1347  
1348  
1349  
1350  
1351  
1352  
1353  
1354  
1355  
1356  
1357  
1358  
1359  
1360  
1361  
1362  
1363  
1364  
1365  
1366  
1367  
1368  
1369  
1370  
1371  
1372  
1373  
1374  
1375  
1376  
1377  
1378  
1379  
1380  
1381  
1382  
1383  
1384  
1385  
1386  
1387  
1388  
1389  
1390  
1391  
1392  
1393  
1394  
1395  
1396  
1397  
1398  
1399  
1400  
1401  
1402  
1403  
1404  
1405  
1406  
1407  
1408  
1409  
1410  
1411  
1412  
1413  
1414  
1415  
1416  
1417  
1418  
1419  
1420  
1421  
1422  
1423  
1424  
1425  
1426  
1427  
1428  
1429  
1430  
1431  
1432  
1433  
1434  
1435  
1436  
1437  
1438  
1439  
1440  
1441  
1442  
1443  
1444  
1445  
1446  
1447  
1448  
1449  
1450  
1451  
1452  
1453  
1454  
1455  
1456  
1457  
1458  
1459  
1460  
1461  
1462  
1463  
1464  
1465  
1466  
1467  
1468  
1469  
1470  
1471  
1472  
1473  
1474  
1475  
1476  
1477  
1478  
1479  
1480  
1481  
1482  
1483  
1484  
1485  
1486  
1487  
1488  
1489  
1490  
1491  
1492  
1493  
1494  
1495  
1496  
1497  
1498  
1499  
1500  
1501  
1502  
1503  
1504  
1505  
1506  
1507  
1508  
1509  
1510  
1511  
1512  
1513  
1514  
1515  
1516  
1517  
1518  
1519  
1520  
1521  
1522  
1523  
1524  
1525  
1526  
1527  
1528  
1529  
1530  
1531  
1532  
1533  
1534  
1535  
1536  
1537  
1538  
1539  
1540  
1541  
1542  
1543  
1544  
1545  
1546  
1547  
1548  
1549  
1550  
1551  
1552  
1553  
1554  
1555  
1556  
1557  
1558  
1559  
1560  
1561  
1562  
1563  
1564  
1565  
1566  
1567  
1568  
1569  
1570  
1571  
1572  
1573  
1574  
1575  
1576  
1577  
1578  
1579  
1580  
1581  
1582  
1583  
1584  
1585  
1586  
1587  
1588  
1589  
1590  
1591  
1592  
1593  
1594  
1595  
1596  
1597  
1598  
1599  
1600  
1601  
1602  
1603  
1604  
1605  
1606  
1607  
1608  
1609  
1610  
1611  
1612  
1613  
1614  
1615  
1616  
1617  
1618  
1619  
1620  
1621  
1622  
1623  
1624  
1625  
1626  
1627  
1628  
1629  
1630  
1631  
1632  
1633  
1634  
1635  
1636  
1637  
1638  
1639  
1640  
1641  
1642  
1643  
1644  
1645  
1646  
1647  
1648  
1649  
1650  
1651  
1652  
1653  
1654  
1655  
1656  
1657  
1658  
1659  
1660  
1661  
1662  
1663  
1664  
1665  
1666  
1667  
1668  
1669  
1670  
1671  
1672  
1673  
1674  
1675  
1676  
1677  
1678  
1679  
1680  
1681  
1682  
1683  
1684  
1685  
1686  
1687  
1688  
1689  
1690  
1691  
1692  
1693  
1694  
1695  
1696  
1697  
1698  
1699  
1700  
1701  
1702  
1703  
1704  
1705  
1706  
1707  
1708  
1709  
1710  
1711  
1712  
1713  
1714  
1715  
1716  
1717  
1718  
1719  
1720  
1721  
1722  
1723  
1724  
1725  
1726  
1727  
1728  
1729  
1730  
1731  
1732  
1733  
1734  
1735  
1736  
1737  
1738  
1739  
1740  
1741  
1742  
1743  
1744  
1745  
1746  
1747  
1748  
1749  
1750  
1751  
1752  
1753  
1754  
1755  
1756  
1757  
1758  
1759  
1760  
1761  
1762  
1763  
1764  
1765  
1766  
1767  
1768  
1769  
1770  
1771  
1772  
1773  
1774  
1775  
1776  
1777  
1778  
1779  
1780  
1781  
1782  
1783  
1784  
1785  
1786  
1787  
1788  
1789  
1790  
1791  
1792  
1793  
1794  
1795  
1796  
1797  
1798  
1799  
1800  
1801  
1802  
1803  
1804  
1805  
1806  
1807  
1808  
1809  
1810  
1811  
1812  
1813  
1814  
1815  
1816  
1817  
1818  
1819  
1820  
1821  
1822  
1823  
1824  
1825  
1826  
1827  
1828  
1829  
1830  
1831  
1832  
1833  
1834  
1835  
1836  
1837  
1838  
1839  
1840  
1841  
1842  
1843  
1844  
1845  
1846  
1847  
1848  
1849  
1850  
1851  
1852  
1853  
1854  
1855  
1856  
1857  
1858  
1859  
1860  
1861  
1862  
1863  
1864  
1865  
1866  
1867  
1868  
1869  
1870  
1871  
1872  
1873  
1874  
1875  
1876  
1877  
1878  
1879  
1880  
1881  
1882  
1883  
1884  
1885  
1886  
1887  
1888  
1889  
1890  
1891  
1892  
1893  
1894  
1895  
1896  
1897  
1898  
1899  
1900  
1901  
1902  
1903  
1904  
1905  
1906  
1907  
1908  
1909  
1910  
1911  
1912  
1913  
1914  
1915  
1916  
1917  
1918  
1919  
1920  
1921  
1922  
1923  
1924  
1925  
1926  
1927  
1928  
1929  
1930  
1931  
1932  
1933  
1934  
1935  
1936  
1937  
1938  
1939  
1940  
1941  
1942  
1943  
1944  
1945  
1946  
1947  
1948  
1949  
1950  
1951  
1952  
1953  
1954  
1955  
1956  
1957  
1958  
1959  
1960  
1961  
1962  
1963  
1964  
1965  
1966  
1967  
1968  
1969  
1970  
1971  
1972  
1973  
1974  
1975  
1976  
1977  
1978  
1979  
1980  
1981  
1982  
1983  
1984  
1985  
1986  
1987  
1988  
1989  
1990  
1991  
1992  
1993  
1994  
1995  
1996  
1997  
1998  
1999  
2000  
2001  
2002  
2003  
2004  
2005  
2006  
2007  
2008  
2009  
2010  
2011  
2012  
2013  
2014  
2015  
2016  
2017  
2018  
2019  
2020  
2021  
2022  
2023  
2024  
2025  
2026  
2027  
2028  
2029  
2030  
2031  
2032  
2033  
2034  
2035  
2036  
2037  
2038  
2039  
2040  
2041  
2042  
2043  
2044  
2045  
2046  
2047  
2048  
2049  
2050  
2051  
2052  
2053  
2054  
2055  
2056  
2057  
2058  
2059  
2060  
2061  
2062  
2063  
2064  
2065  
2066  
2067  
2068  
2069  
2070  
2071  
2072  
2073  
2074  
2075  
2076  
2077  
2078  
2079  
2080  
2081  
2082  
2083  
2084  
2085  
2086  
2087  
2088  
2089  
2090  
2091  
2092  
2093  
2094  
2095  
2096  
2097  
2098  
2099  
2100  
2101  
2102  
2103  
2104  
2105  
2106  
2107  
2108  
2109  
2110  
2111  
2112  
2113  
2114  
2115  
2116  
2117  
2118  
2119  
2120  
2121  
2122  
2123  
2124  
2125  
2126  
2127  
2128  
2129  
2130  
2131  
2132  
2133  
2134  
2135  
2136  
2137  
2138  
2139  
2140  
2141  
2142  
2143  
2144  
2145  
2146  
2147  
2148  
2149  
2150  
2151  
2152  
2153  
2154  
2155  
2156  
2157  
2158  
2159  
2160  
2161  
2162  
2163  
2164  
2165  
2166  
2167  
2168  
2169  
2170  
2171  
2172  
2173  
2174  
2175  
2176  
2177  
2178  
2179  
2180  
2181  
2182  
2183  
2184  
2185  
2186  
2187  
2188  
2189  
2190  
2191  
2192  
2193  
2194  
2195  
2196  
2197  
2198  
2199  
2200  
2201  
2202  
2203  
2204  
2205  
2206  
2207  
2208  
2209  
2210  
2211  
2212  
2213  
2214  
2215  
221